Date: _12/31/2015___

EIC Detector R&D Progress Report

Project ID: eRD15__
Project Name: __Compton Electron detector R&D _____
Period Reported: from__08/2015___ to__12/31/2015____
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Abstract

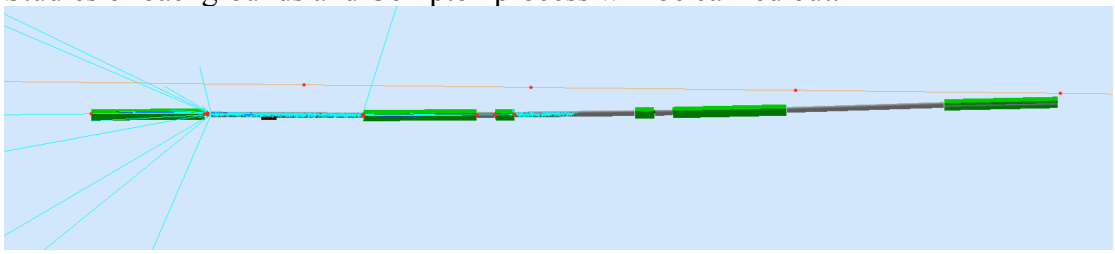
The best Compton polarization measurement made up to date was done at SLAC at the SLD experiment and reached 0.52 % accuracy on the polarization using the detection of the Compton electron.
The same technique can be used for EIC to reach the goal of subpercent electron polarization measurement. Though the significantly higher operating current of the EIC will introduce new challenges in term of backgrounds, counting rates and radiation hardness. At current as high as 3 amperes for Jlab EIC, a significant amount of shielding is needed in order to reduce the RF power deposited in the detector. We are invistigating the use of a roman pot design for electron detection which can provide shielding and convenient access to the detector. Though additionnal material will be put in the way of the Compton electrons which can affect the measurement The goal of this proposal is to have a full simulation of a Compton electron detector setup to study the effect of background and shielding on the measurement to insure a subpercent measurement can be reached. The simulation will be cross checked at Jefferson Laboratory using the current Compton polarimeter setup. Following up to the successfull operation of the Hall C Compton diamond detector, our default option for EIC is a diamond detector which exhibits very good radiation hardness and has potential for faster response than silicon. Modification of the current Jefferson Laboratory polarimeters is proposed in order to be able to carry out shielding tests and electronics test to determine the fastest time response achievable of the diamond detector using the current detectors and later optimized detectors for EIC.

Introduction

Past

What was planned for this period?
The Committee provided the following recommendation for eRD15: The group is encouraged to proceed with the simulations for the design of a Compton Polarimeter at the MEIC.

What was achieved?
University of Manitoba through Pr. Juliette Mammei has agreed that Joshua Hoskins current postdoctoral research associate will spend 50 % of his time on the EIC Compton Electron Detector Simulation and R&D. He will be the main developer of the simulation.
Setup of the contracts is almost complete.
Simulations work has progressed at a steady rate and is now ready to start studying the effects of backgrounds in the Compton chicane. The primary focus of the simulations work up to this point has been on the implementation of various geometries into GEMC, which is a GEANT4 based Monte Carlo package used in the simulations studies. The addition of these geometries provided the means to easily add the beam pipes to the Compton chicane within the simulations framework. Now that this work has been finished. Studies of backgrounds and Compton process will be carried out.



The silicon vertex detector group of the Hall B CLAS12 was contacted and expertise as well as wire bonding hardware is available locally allowing testing the timing resolution of the sensors with electronics on the detector.

What was not achieved, why not, and what will be done to correct?
Full modelling of the detector setup is not completing yet mostly due to initial setup of the fund transfer and learning curve of the simulation package. We are on track to have a first iteration complete for the summer and have a preliminary study of the background with a cross check with the existing Geant 3 simulation.

Future

What is planned for the next funding cycle and beyond? How, if at all, is this planning different from the original plan?
For this funding cycle
Completions of the first pass beamline design of the Compton and study of background and detector response.
Design of the test stand.
Contact the TOTEM collaboration.

For the next funding cycle
We will request additional 85 k$ fund for construction of a new vacuum chamber and the electronics test stand to start the work on timing response of the detector for a total of about 140 K$.
What are critical issues?
The main challenges for the a Compton Electron Detector compared to the SLAC or JLab operation is the current which will be several order of magnitude higher with a maximum current of 50 mA at eRHIC and up to 3 A at mEIC. The goal of this proposal is to study the effect of the Compton rates and backgrounds in the detectors at such high intensity and the effect on the measurement caused by the addition of shielding required to handle the background. Speed of the diamond detector will be optimized to allow bunch to bunch measurement at least at the eRHIC repetition rate of 10.8 MHz.
In the JLab EIC option, the Compton polarimeter is placed after the interaction point, the effect of this "background" will also be evaluated.
Crosscheck of the simulation will be done with beam tests at Jefferson Laboratory where sub percent polarization measurement is already achieved and potentially at other facilities such as a storage ring.

Manpower

Include a list of the existing manpower and what approximate fraction each has spent on the project. If students and/or postdocs were funded through the R&D, please state where they were located and who supervised their work.

Alexandre Camsonne Jefferson Laboratory 15 %
David Gaskell Jefferson Laboratory 15 %
Joshua Hoskins University of Manitoba Postdoc funded by EIC money located at Jefferson Laboratory Newport News, VA 23606 at 50 % and supervised by David Gaskell and Alexandre Camsonne.

External Funding

No additional source of funding

Publications

Please provide a list of publications coming out of the R&D effort.
No publication